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14. ABSTRACT

In the years since the attacks of September 11, 2001, the United States Department of Defense intelligence organizations have not provided adequate warning to decision makers about events in the strategic environment. The coming decade will see advances in worldwide interconnectivity coupled with shifting ideas about how people wield power, resulting in a strategic environment that is increasingly complex. Current intelligence analytical methods, based on reductionist approaches to science, are insufficient for allowing analysts to view the international system holistically and anticipate unexpected behavior or activity. Complexity theory offers promise in allowing analysts to comprehend the strategic environment better. Complexity theory focuses on relationships between components of complex systems and provides alternative ways of considering emergent behavior based on the introduction of different stimuli. The incorporation of the principles of complexity theory into analyst training will provide intelligence analysts with additional tools to keep strategic leaders better informed and help prevent future strategic surprise.

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JOINT ADVANCED WARFIGHTING SCHOOL

SHIFTING PERSPECTIVES: USING COMPLEXITY THEORY TO ANTICIPATE STRATEGIC SURPRISE

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A paper submitted to the Faculty of the Joint Advanced Warfighting School in partial satisfaction of the requirements of a Master of Science Degree in Joint Campaign Planning and Strategy. The contents of this paper reflect my own personal views and are not necessarily endorsed by the Joint Forces Staff College or the Department of Defense. This paper is entirely my own work except as documented in footnotes.

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In the years since the attacks of September 11, 2001, the United States Department of Defense intelligence organizations have not provided adequate warning to decision makers about events in the strategic environment. The coming decade will see advances in worldwide interconnectivity coupled with shifting ideas about how people wield power, resulting in a strategic environment that is increasingly complex. Current intelligence analytical methods, based on reductionist approaches to science, are insufficient for allowing analysts to view the international system holistically and anticipate unexpected behavior or activity. Complexity theory offers promise in allowing analysts to comprehend the strategic environment better. Complexity theory focuses on relationships between components of complex systems and provides alternative ways of considering emergent behavior based on the introduction of different stimuli. The incorporation of the principles of complexity theory into analyst training will provide intelligence analysts with additional tools to keep strategic leaders better informed and help prevent future strategic surprise.

CONTENTS

LIST OF FIGURES

Figure

ACRONYMS

ACH	Analysis of Competing Hypotheses
CJCS	Chairman of the Joint Chiefs of Staff
DIE	DOD Intelligence Enterprise
DOD	Department of Defense
IC	Intelligence Community
ISIL	Islamic State of Iraq and the Levant
SCA	Socio-Cultural Analysis
SNA	Social Network Analysis
TCO	Transnational Criminal Organization
U.S.	United States
WMD	Weapons of Mass Destruction

CHAPTER 1
MAKING INTELLIGENCE WORK

The U.S. Intelligence Community's (IC) many recent failures to provide sufficient and timely strategic warning have led to calls for changes in analytical tradecraft. Multiple recent events on the world stage have served to bolster the case that analytical tradecraft in its current form has shortcomings that require innovative solutions. In the years since the attacks of 2001, the IC failed to provide adequate warning of the 2006 resurgence of the Taliban in Afghanistan, the 2011 so-called "Arab Spring" uprisings, the 2014 Russian invasion of Ukraine, and the rise of the Islamic State following the war in Iraq. Considering the amount of money, time, and emphasis placed on intelligence, one must ask why strategic intelligence has continued to underperform.

Each of the events noted above demonstrate an unpredicted new behavior that emerged from a series of events. Some of the events were reactions to U.S. activities, while others came about due to internal changes or to changes in the environment. Each event also forced the United States to respond in some way, showing the degree of the world's interconnectedness. U.S. leadership relies on intelligence analysts to anticipate these worldwide events in order to prevent strategic surprise.

Current analyst training is insufficient for anticipating events in this complex strategic environment. The sheer number of unforeseen events highlights the need for new ways of educating analysts. To prevent further strategic surprise, the Department of Defense (DOD) Intelligence Enterprise (DIE) must train strategic analysts to use new models for thinking about the environment and incorporate new analytical practices to

better anticipate future events. Without these necessary adaptations, the DIE will continue to fall short of decision-maker expectations.

Proper application of the principles of complexity theory will provide analysts with a better method to anticipate future events. Intelligence professionals must learn and understand complexity theory during their analytical tradecraft training. Today's standard analytical tradecraft, while still useful, is not sufficient to produce timely warning about world events. Analysts must broaden their understanding of the interconnectedness and changing landscape of the increasingly complex post-Cold War strategic environment.

NOT YOUR FATHER'S "WAR"

A look at security and defense activities in October 2014 reveals the diverse nature of the strategic environment and corresponding U.S. military operations. These activities include conducting air strikes in Iraq and Syria to combat the Islamic State of Iraq and the Levant (ISIL),[1] combatting the spread of Ebola in West Africa,[2] deterring aggression on the Korean peninsula,[3] assisting Honduran efforts to combat transnational crime,[4] and conducting training and counterterrorism missions in Afghanistan.[5] The

1. Tony Capaccio, "Islamic State Dispersing Makes U.S Adapt Targets," *Bloomberg News*, October 1, 2014, http://www.bloomberg.com/news/2014-09-30/islamic-state-dispersing-compels-u-s-to-adapt-airstrikes.html (accessed October 22, 2014).

2. David Warren and Lauran Neergaard, "Government Confirms First Case of Ebola in US," *Associated Press*, September 30, 2014, http://bigstory.ap.org/article/ce39cccd6c534487ba2640e94def757c/us-ebola-labs-parts-clinic-arrive-liberia (accessed October 22, 2014).

3. Anna Fifield, "North Korean Officials Pay Rare and Surprising Visit to the South," *The Washington Post*, October 4, 2014, http://www.washingtonpost.com/world/north-korean-officials-pay-surprise-visit-to-the-south/2014/10/04/383e76f1-f39c-4c10-9889-12bfce88e150_story.html (accessed November 2, 2014).

4. Steven Stubbs, "Joint Task Force-Bravo Commences Operation Caravana with Honduran Military," *Joint Task Force-Bravo Public Affairs Office*, October 9, 2014, http://www2.southcom.mil/Apps/Home/Spotlight/ (accessed October 22, 2014).

5. Yochi Dreazen, Gopal Ratnam, "America's Longest War Could Get Even Longer," *Foreign Policy*, September 30, 2014 http://complex.foreignpolicy.com/posts/2014/09/30/americas_longest_war_could_get_even_longer_afghanistan_troops_bsa (accessed October 22, 2014).

factors that make the operating environments so complex include multiple friendly, adversarial, and neutral actors, each of whom interacts with each other and the surrounding environment. Events in one part of the world affect actors in other parts with surprising speed.

In the coming decade, the U.S. military will continue to function across the range of military operations and against a multitude of diverse threats. In the *Capstone Concept for Joint Operations: Joint Force 2020*, the Chairman of the Joints Chiefs of Staff (CJCS) asserted that the nation will face a more dangerous and complex strategic environment as it transitions from the recent period of war. New technologies and the importance of space and cyberspace will create an environment in which the traditional notions of war, and the conventional methods of thinking about conflict, will no longer be useful.[6] Specifically, the CJCS challenged the DIE to advance its analytical tradecraft to meet commanders' needs in the new, more complex strategic environment. This new tradecraft is essential to provide broader intelligence to decision-makers, including warnings about events that could lead to war.[7] In order to provide predictive analysis and adequate warning to strategic leaders, the DIE must adapt its analytical tradecraft to incorporate the principles and common characteristics of complexity theory or risk becoming increasingly irrelevant in an ever more dangerous and turbulent world.

RECENT INTELLIGENCE SHORTFALLS

Over the last decade, many leaders and analysts have scrutinized the performance of the DIE and found it wanting. In the mid-2000s, the RAND Corporation examined the

6. *Capstone Concept for Joint Operations: Joint Vision 2020* (Washington, D.C.: Joint Chiefs of Staff, 2012), 2-3.

7. Ibid., 10.

state of analysis across the U.S. Intelligence Community (IC). According to its 2008 report, IC analysts, including defense intelligence analysts, believed they spent most of their time concentrating on immediate, near-term needs, such as targeting. The focus on near-term events prevented many analysts from becoming experts on particular geographic or functional subjects.[8] More importantly, the focus on targeting and current events prevents analysts from viewing the environment holistically as they instead focused primarily on their target and that target's immediate connections.

Other calls for change have specifically addressed defense intelligence support for counterinsurgency operations. Perhaps most famously, in "Fixing Intel: A Blueprint for Making Intelligence Relevant in Afghanistan," then Major General Michael Flynn criticized intelligence organizations supporting operations in Afghanistan for focusing too much on the enemy and not enough on the people of Afghanistan and other environmental factors.[9] In a similar critique of DOD intelligence, a 2012 RAND Occasional Paper examined intelligence in a counterinsurgency environment and concluded that analysts tended to focus exclusively on enemy capability and intentions. When analysts did broaden their scope to include more environmental factors, they tended to segregate elements into "red" (enemy), "blue" (friendly), "green" (neutral), and "white" (socio-cultural) categories, which obstructed the analysts' ability to appreciate

8. Gregory F. Treverton, and C. Bryan Gabbard, *Assessing the Tradecraft of Intelligence Analysis* (Santa Monica, CA: RAND Corporation, 2008), http://www.rand.org/pubs/technical_reports/TR293.html (accessed October 2, 2014).

9. Michael T. Flynn, Matt Pottinger, and Paul D. Batchelor, "Fixing Intel: A Blueprint for Making Intelligence Relevant in Afghanistan," Voices from the Field, *Center for a New American Security*, 2010, http://www.cnas.org/files/documents/publications/AfghanIntel_Flynn_Jan2010_code507_voices.pdf (accessed October 2, 2014).

the interconnectedness between entities in other categories.[10] In an article published in 2014 on the *Small Wars Journal* website, another author pointed to the difficulty U.S. military forces had in comprehending their environments due to the numerous interconnected factors affecting their operations.[11] All of this leads to the inescapable conclusion that current analytical methods are not suitable for gaining a holistic view and an appreciation for the interconnectedness among the many factors that contribute to the strategic environment.

GAINING STRATEGIC ADVANTAGE WITH COMPLEXITY THEORY

Complexity theory strives to illuminate and comprehend the connections between diverse elements. While experts have not yet agreed upon definitive principles to describe complex systems, these systems generally have the common traits of diverse elements, interconnectedness, self-organization, adaptation and emergence, and non-linearity.[12] Complex systems behave in a different manner than closed systems, which demonstrate the behaviors of proportionality, linearity, replication, and cause-and-effect. In a process known as reduction, analysts can deconstruct closed systems to their basic parts to determine how they function. The application of a stimulus to a closed system will result in a predictable and repeatable outcome.[13] Examples of closed systems abound in chemistry labs, and, one could say, to some degree in the Cold War political and military

10. Ben Connable, *Military Intelligence Fusion for Complex Operations: A New Paradigm* (Santa Monica, CA: RAND Corporation, 2012), http://www.rand.org/pubs/occasional_papers/OP377.html (accessed October 2, 2014).

11. Stephen Draper, "Intelligence in Complex Environments," *Small Wars Journal*, August 1, 2014, http://smallwarsjournal.com/jrnl/art/intelligence-in-complex-environments (accessed October 2, 2014).

12. Scott E. Page, *The Great Courses: Understanding Complexity* (Chantilly, VA: The Teaching Company, 2009), lecture 3.

13. Thomas J. Czerwinski, *Coping with the Bounds: A Neo-Clausewitzian Primer* (Washington, DC: CCRP Publications Series, 2008), 8-9.

system. As a chemistry experiment will repeatedly provide predictable results, rigid Soviet doctrine allowed U.S. intelligence analysts to expect predictable, repeatable behavior. Conversely, complex systems are open in the sense that components interact with each other and with their environment. Complex systems are also non-linear, meaning they react to stimuli in unexpected ways.[14] These characteristics, which are abundant in today's strategic environment, make complex system behavior especially difficult to predict. Thus, reductionist methods will no longer work, and intelligence analysts need a new way of understanding the post-Cold War world.

To comprehend complex systems more thoroughly, intelligence analysts must study them using different tools than those used to analyze closed systems. Analysts can, practicing traditional analytical methods, reduce a closed system to its components, understand each component thoroughly, and then use that understanding to predict future behavior. By contrast, studying the behavior of the individual components of a complex system will not provide an understanding of how that system works, because the interdependence and feedback between the components is more important than the components themselves.[15] By considering the nature of the connections between elements of complex environments, however, analysts can begin to gain a greater appreciation of potential stimuli and probable adaptive and emergent behaviors. This understanding will lead to more accurate and timely strategic warning for U.S. political and military leadership and could prevent the next foreign policy or security disaster.

14. Neil Johnson, *Simply Complexity: A Clear Guide to Complexity Theory* (Oxford, UK: OneWorld Publications, 2007), 15.

15. James Jay Carafano and Richard Weitz, "Complex Systems Analysis-A Necessary Tool for Homeland Security," Backgrounder #2261 on Department of Homeland Security (April 16, 2009), http://www.heritage.org/research/reports/2009/04/complex-systems-analysis-a-necessary-tool-for-homeland-security (accessed September 16, 2014).

Clearly, current analytical methods have not adequately provided sufficient warning to U.S. leadership over the last decade. The DOD must discard the old way of thinking about the strategic environment along with other relics of the Cold War era such as the doctrine of Mutually Assured Destruction, the Pentomic structure[16], and AirLand Battle Doctrine. Gaining a decision advantage suitable for tomorrow's diverse, interconnected, and adapting environment requires a new way of understanding the world. Complexity theory can provide the foundational basis for understanding the diverse, dynamic relationships of the world in which the U.S. military will operate into the future.

How should the DIE evolve its processes, training and foundational mindset to remain effective? Chapter 2 highlights many of the strategic environmental factors that will continue to frustrate intelligence analysts unless they modify their Cold War analytical tradecraft. Chapter 3 dissects the current state of analytical tradecraft and identifies its shortcomings when used to anticipate events within complex systems. Chapter 4 discusses the concepts that comprise complexity theory and how practitioners can use those ideas when dealing with real-world complex systems. Chapter 5 proposes how the DOD intelligence establishment can incorporate complexity theory into current analytical techniques to better anticipate events and prevent strategic surprise. Chapter 6 concludes with recommendations for overcoming obstacles to innovation and improving U.S. defense intelligence analytical tradecraft.

[16] In response to the perceived nuclear threat of the 1950s, the U.S. Army reorganized into a divisional structure with five subordinate organizations. Army leaders believed this was the optimal structure for operating on a nuclear battlefield.

CHAPTER 2

THE WORLD IS BECOMING MORE COMPLEX

Joint doctrine characterizes the future strategic environment as one of "uncertainty, complexity, rapid change, and persistent conflict," and states that future global events will feature the continuation of current trends as well as ambiguity and surprise.[1] Undoubtedly, the future will be increasingly complex due to technological transformation, societal and political change, climate variations, and other unexpected and unforeseeable causes. Defense intelligence professionals must consider these characteristics when designing tradecraft suitable for the coming years.

CONTINUING TRENDS

Many characteristics of today's environment show no signs of abating in the next decade. Transnational threats such as terrorism, transnational organized crime, and the proliferation of weapons of mass destruction (WMD) will persist, as will interstate, intrastate, and transnational conflict that will impair the ability of the United States and its allies to achieve their strategic goals. Space and cyberspace will also continue to play an increasingly significant role in shrinking the globe.

Organizations committed to bringing political change through violence will continue to use the tools of terror in the next ten years; however, it is also likely that terrorist tactics will evolve. In his January 2014 testimony to the Senate Select Committee on Intelligence, the Director of National Intelligence stated that large terrorist organizations such as al-Qaeda have given way to smaller, more diffuse, and regional

1. U.S. Joint Chiefs of Staff, *Doctrine for the Armed Forces of the United States*, Joint Publication 1 (Washington, DC: U.S. Joint Chiefs of Staff, March 25, 2013), I-10.

actors as well as homegrown violent extremists.[2] As intelligence and security organizations become more able to discover and prevent organized terrorist operations, the rise of "lone wolf" attacks, or those committed by individuals with no clear ties to terrorist organizations, will likely become more prevalent.[3] Violent attacks such as the 2013 Boston Marathon bombing and 2014 strikes on government figures in Canada, New York, Australia, and Belgium, seemingly arose from nowhere as intelligence agencies were unable to perceive the environmental changes that precipitated the events.[4] These type of attacks present a daunting challenge to intelligence organizations, as they do not provide analysts with familiar signatures. Instead, analysts must attempt to identify critical environmental changes that might spur activity that culminates in an act of terrorism. Providing decision-makers with sufficient warning without the benefit of a clear chain of causal events has proven extremely difficult.

Transnational criminal organizations (TCOs), in a manner similar to terrorist organizations, will continue to pose a challenge to U.S. national security interests. In 2010, the United Nations concluded that globalization allows TCOs to develop at a faster pace than world governments are able to police them.[5] Further, the increasing worldwide interconnectedness of businesses and the financial industry, coupled with growing on-line

2. James Clapper, *Statement for the Record; Worldwide Threat Assessment of the US Intelligence Community, Senate Select Committee on Intelligence*, January 29, 2014, 4, http://www.dni.gov/files/documents/Intelligence%20Reports/2014%20WWTA%20%20SFR_SSCI_29_Jan.pdf (accessed October 29, 2014).

3. R. Abdulrahim, "Simple Yet Terrifying; Lone-Wolf Attacks in Canada and New York Appear Inspired by an Islamic State Call," *Los Angeles Times*, October 29, 2014, http://search.proquest.com.nduezproxy.idm.oclc.org/docview/1617659426?accountid=12686 (accessed November 2, 2014).

4. The Associated Press, "Islamic State calls on Muslims to attack West," *Military Times*, January 26, 2015, http://www.militarytimes.com/story/military/pentagon/2015/01/26/islamic-state-calls-on-muslims-to-attack-west/22348047/ (accessed January 27, 2015).

5. United Nations, *Transnational Organized Crime Threat Assessment* (New York, 2010), 29.

commerce, opens the door for a "major escalation" of organized criminals to exploit the cyber domain.[6] Transnational organized crime encompasses vast swaths of society, including government organizations, security and military services, financial institutions, businesses, and the criminal actors themselves, greatly increasing complexity due to the number of relationships between the actors that intelligence analysts must consider.

The proliferation of WMD will also continue to pose a threat in the coming years. Increasing globalization and growing networks allows easier and more rapid transmission of dangerous WMD knowledge, technology, and expertise, particularly in the areas of biological and chemical weaponry.[7] To add to the complexity, some of the actors involved in WMD proliferation may also participate in terrorism or transnational crime. This confluence provides an example of why it is important for analysts to view the environment holistically rather than attempt to reduce discrete threats into their component parts.

Additionally, unstable regions will continue to threaten U.S. interests or allies. Resource scarcity and resource security, including access to food, water, and energy, will act as accelerants of instability, particularly within regions at risk due to a harsh natural climate, weak economic conditions, or unstable governments.[8] Specifically, the combination of political, economic, societal, criminal, and climatic conditions in the Middle East, East Asia, and Sub-Saharan Africa will continue to bedevil analysis of the strategic environment. These environmental factors increase activity detrimental to U.S.

6. *Global Risks 2014, Ninth Edition*, World Economic Forum, 2014, www.weforum.org/risks (accessed November 2, 2014).

7. Clapper, 5.

8. Ibid., 9-10.

policy objectives and exacerbate the instability of the international system. This non-linear nature allows a small event to result in large consequences for the United States.

Space and cyberspace, already critical in daily life, will host increasing threats. As of mid-2014, over 1,200 functioning government, military, and commercial satellites provide communications, reconnaissance, meteorology, navigation, scientific research, or other services.[9] Launch numbers have generally increased every year over the last decade, indicating a trend toward the expanded use of space in the coming years. At the same time, growing amounts of business, government, and social information functions are transitioning from old media to cyberspace.[10] Likewise, a growing amount of critical infrastructure, commercial, and home electronic devices connect through digital networks, exposing them to threats from malicious hacking and sabotage.

These trends increase the complexity of the strategic environment in two ways. First, they create more interconnected elements within the international system. Each additional node in the system, whether friendly, neutral, or adversarial, will affect how the system responds to stimuli. Second, the increasing capabilities of information technology allow information to travel between nodes at an even faster rate than before. Thus, social groups can adapt more quickly to stimuli, reducing the amount of time analysts have to warn decision-makers about potential threat activities.

THE UNCERTAIN FUTURE

New security challenges will emerge in the next decade, adding more complexity to the strategic environment. In *Global Trends 2030*, the National Intelligence Council

9. Union of Concerned Scientists, "UCS Satellite Database," August 1, 2014, http://www.ucsusa.org/nuclear_weapons_and_global_security/solutions/space-weapons/ucs-satellite-database.html#.VFEXxfmPeSo (accessed October 29, 2014).

10. Clapper, 1.

identified several trends likely to occur in the next decade. These trends include changes in ideas about power and the growing interconnectedness of the competition for scarce resources.[11] These trends will require intelligence analysts to consider the potential threat activities of a variety of new actors.

Global Trends 2030 asserts that the idea of what constitutes power will shift in the coming years. Historically, states have been the centers of power, although non-state actors such as corporations have increased their share of power over the years. However, new information technology and increased networking and globalization may lead to a point where small groups or even individuals can have outsize effects on world events. With improved technology, individuals could more easily gain access to information and expertise about disruptive technologies and weapons, increasing their ability to harm U.S. security interests.[12] As ideas about power transform, networks or otherwise disparate groups may converge to influence events. The power of future super-empowered individuals could eclipse that previously wielded by Pablo Escobar in the criminal world or Osama bin Laden in the realm of terrorism. Intelligence organizations will have to contend with the likelihood that information technology will give power to new categories of individuals, increasing the scope of those organizations' analytical responsibilities.

Increasing globalization and interconnectedness between states and non-state actors complicates international relations and opens new mission sets for the U.S. military, such as coping with environmental challenges and pandemic disease. Then

11. National Intelligence Council, *Global Trends 2030: Alternative Worlds* (Washington, D.C., 2012), www.dni.gov/nic/globaltrends (accessed October 29, 2014).

12. Ibid., 9.

Secretary of Defense Chuck Hagel referred to these potential missions in the *Department of Defense 2014 Climate Change Adaptation Roadmap*, in which he called climate change a "threat multiplier" because it can exacerbate the threats the United States already faces. For example, climate change can increase the complexity of fighting diseases by changing disease vectors, resulting in new types of diseases appearing in places they never have before. Expanding commercial air travel increases the number of nodes and types of disease vectors as well. As the Secretary stated, "the military could be called upon more often to support civil authorities, and provide humanitarian assistance and disaster relief in the face of more frequent and more intense natural disasters."[13] Thus, not only will the future environment be more complex, but the U.S. military will conduct missions that are more diverse. Each of these factors creates new warning challenges for intelligence analysts. Simply put, the future trends coupled with future uncertainty necessitate a fundamental shift in analytical tradecraft.

CHALLENGES FOR ANALYSTS

The current environment already provides a complex set of challenges for strategic analysts. The future will certainly present new and varied threats to U.S. interests. Among all the strategic variables, however, certain factors will increase complexity, greatly challenging the ability of analysts to provide timely warning.

The state, or even a recognized non-state actor, may not be the most powerful entity. Instead, power may emerge from an unrecognizable or yet unformed group. One could liken such groups to a cyberspace "flash-mob" by which an event or message initiates an online congregation of like-minded, anonymous, and geographically

13. United States Government, *Department of Defense 2014 Climate Change Roadmap* (Washington, D.C. 2014), foreword.

separated individuals who come together virtually for a specific purpose. Once the group members achieve their purpose, they disassociate and await the next initiating event, which may connect them to an entirely different group of people. This phenomenon makes the identity of the individual participants less important than the relationships between them, and does not present an analyst with a clear, repeatable pattern. This behavior is already occurring as anti-American foreign fighters travel around the world to battle the United States in places like Iraq and Syria, and "hacktivists" temporarily unite on-line to accomplish various objectives.

In the coming years, the United States will face new technologies that are either now in their infancy or yet unconceived. For reference, an intelligence analyst from ten years ago would not have had to consider the implications of now commonplace social media outlets such as Facebook, Twitter, or Instagram. Nor would that analyst have considered the widespread use of cell phone technology, which allows individuals to interconnect and disseminate information around the world almost instantaneously.[14] These technologies have already had a tremendous impact on the way information flows across the global environment, which ultimately affects political, economic, and military decisions. Likewise, an analyst today cannot know the new technologies that will have a similar impact on social dynamics in the next decade. This combination of technological impacts will greatly increase the difficulty for analysts to provide sufficient warning.

Additionally, the U.S. military will face declining budgets and changing political considerations resulting in a reduction of forward deployed military presence. This

14. Jon M. Chang, "Then and Now: How the World Has Changed since Facebook Was Born 10 Years Ago," *ABC News*, February 4, 2014, http://abcnews.go.com/Technology/facebook-turns-10-years-old/story?id=22351547 (accessed October 29, 2014).

presents additional challenges to analysts for a couple of reasons. First, strategic analysts will lose a potential source of information about governmental, military, and societal factors in locations vacated by the troops. Second, as *Joint Publication 1* states, "unpredictable crises call for trained and ready forces that are either forward deployed or are rapidly and globally deployable."[15] Because the United States will deploy fewer military forces forward, the forces that do react will have to travel additional distances to get to crisis locations and will therefore require warning farther in advance to account for the longer deployment times. Taken together, these factors will increase the challenge to anticipate and identify threat scenarios accurately while simultaneously increasing the amount of time it takes analysts to receive relevant information and determine the situation on the ground. Having analysts trained to employ suitable analytical tradecraft will be of utmost importance.

15. *Joint Publication 1*, II-7.

CHAPTER 3

SHORTCOMINGS IN INTELLIGENCE ANALYSIS

Due to the speed at which information travels in complex systems, analysts will have to process more information in less time. At its core, analytical tradecraft consists of processing data and information into intelligence about the current and future strategic environment that is useful for policy- or decision-makers. It is fundamentally a personal, internal mental process.[1] As such, it is subject to the vagaries of the performance of each individual's brain, including mind-set, memory, and perception problems.[2] Intelligence analysis is a method to overcome these mental limitations to provide commanders and decision-makers with useful input from the unlimited data in the strategic environment.

CLOSED SYSTEM THINKING IN AN OPEN SYSTEM WORLD

The U.S. IC has made great strides in developing an analytical tradecraft for its practitioners. Recognizing the difficulty of comprehending the strategic environment, IC leaders have developed techniques to standardize intelligence analysis in an attempt to reduce uncertainty and improve warning. IC leaders also understand the shortfalls of the human brain and have developed methods to help analysts overcome those limitations when examining the environment.

Current tradecraft, however, relies on structured analytical techniques. Due to limitations of the human brain's ability to remember large amounts of data, the IC teaches several techniques that involve breaking complicated issues into component

1. Richards J. Heuer, Jr., *Psychology of Intelligence Analysis* (Washington D.C.: Center for the Study of Intelligence, 1999), 1.
2. Ibid., 2-6.

parts. Analysts create a simplified model of each component and then recreate the whole from the simplified components.[3] This is a natural process to try to comprehend a complex, multi-faceted environment. The IC adopted these practices from Newtonian science, which seeks cause-and-effect laws that govern behavior.[4] Analysts learn that behavior in the strategic environment is predictable, and once they determine the appropriate indicators, the resultant effect will follow per natural law.

One of the most widely taught techniques is analysis of competing hypotheses (ACH), which is designed to allow an analyst to evaluate large amounts of evidence that may lead to a predictive outcome.[5] Using this method, analysts learn to look at future events following linear approaches and determining cause-and-effect relationships. Usually analysts create a matrix with hypotheses on one axis and indicators or evidence on the other (figure 1). Analysts then evaluate the consistency of each piece of evidence against each of the hypotheses. As new evidence emerges, analysts can then determine which of the hypothesis is most consistent with collected or observed intelligence, and eliminate inconsistent hypotheses.

3. Heuer, 27.
4. Czerwinski, 42-43.
5. U.S. Government, *A Tradecraft Primer: Structured Analytical Techniques for Improving Intelligence Analysis*, March 2009, 14-15, https://www.cia.gov/library/center-for-the-study-of-intelligence/csi-publications/books-and-monographs/Tradecraft%20Primer-apr09.pdf, (accessed October 2, 2014).

Question: Will Iraq Retaliate for US Bombing of Its Intelligence Headquarters?

Hypotheses:
H1 - Iraq will not retaliate.
H2 - It will sponsor some minor terrorist actions.
H3 - Iraq is planning a major terrorist attack, perhaps against one or more CIA installations.

	H1	H2	H3
E1. Saddam public statement of intent not to retaliate.	+	+	+
E2. Absence of terrorist offensive during the 1991 Gulf War.	+	+	−
E3. Assumption that Iraq would not want to provoke another US attack.	+	+	−
E4. Increase in frequency/length of monitored Iraqi agent radio broadcasts.	−	+	+
E5. Iraqi embassies instructed to take increased security precautions.	−	+	+
E6. Assumption that failure to retaliate would be unacceptable loss of face for Saddam.	−−	+	+

Figure 1. Sample analysis of competing hypotheses (ACH) matrix[6]

A related technique is pattern analysis, with which specialists correlate data, looking for repetition or other common traits that can identify trends. A corollary to pattern analysis is anomaly analysis, or identifying an activity that breaks an otherwise known pattern.[7] These techniques are particularly useful in analysis of a closed system, in which activities recur predictably. In non-linear, complex systems, they are not as useful.

6. Heuer, 101.

7. Julie Paynter, "Bringing Baker Street to Fort Huachuca: Enlisting Sir Arthur Conan Doyle to Teach Intelligence Analysis," *Military Intelligence Professional Bulletin* 37, no. 3 (July 2011): 62-7,

Some other common analytical techniques are suited to examining open systems and are therefore more suitable to incorporating complexity theory. For example, social network analysis (SNA), socio-cultural analysis (SCA), and "outside-in thinking" are good starting points for analysts to become familiar with the environment; however, none of these techniques sufficiently considers relationships between entities necessary to anticipate behavior that is difficult to predict.

SNA is helpful to begin identifying network components and interrelationships. Joint Publication 2-0, *Joint Intelligence,* describes SNA as analyzing an individual's interpersonal, professional, and social ties.[8] Using SNA, analysts identify relationships between entities and their environment. Those relationships may exist between people, organizations, businesses, locations, or any number of other types of physical or intangible entities. Analysts also identify the dynamics and the nature of the relationships between those entities.[9] Identifying relationships between actors is a critical first step for working with complexity.

SCA is "the analysis of adversaries and other relevant actors that integrates concepts, knowledge, and understanding of societies, populations, and other groups of people, including their activities, relationships, and perspectives across time and space at varying scales."[10] An even less structured technique is "outside-in thinking," which uses creative thinking to identify all of the critical factors in the strategic environment that

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http://search.proquest.com.nduezproxy.idm.oclc.org/docview/1017696485?accountid=12686 (accessed November 10, 2014).

8. U.S. Joint Chiefs of Staff, *Joint Intelligence*, Joint Publication 2-0 (Washington, DC: U.S. Joint Chiefs of Staff, October 22, 2013), I-18.

9. David A. Bright, Caitlin E. Hughes, and Jenny Chalmers, "Illuminating Dark Networks: A Social Network Analysis of an Australian Drug Trafficking Syndicate," *Crime, Law and Social Change* 57, no. 2 (March, 2012): 151-76, http://search.proquest.com.nduezproxy.idm.oclc.org/docview/920371827?accountid=12686 (accessed November 12, 2014).

10. *Joint Publication 2-0,* GL-11.

may have an impact on the situation at hand.[11] These processes are essential first steps for analysts to identify the actors, relationships, and critical factors in the strategic environment, but do not provide analysts with the tools to identify adaptation and emergent behavior in response to environmental changes.

FIXING STRATEGIC ANALYSIS

Although the IC has made progress in standardizing analytical techniques, observers of analytical performance have noted deficiencies in current tradecraft. Many of these deficiencies emerged over the last decade of operations in Afghanistan and Iraq. Most of the observations apply to both the operational and strategic levels of analysis.

One noted deficiency is the focus on short-term intelligence, particularly for targeting purposes, at the expense of developing a long-term understanding of the environment. This focus on recent operations and current intelligence prevents analysts from gaining a deep understanding of the components of the various systems at the strategic level. Across much of the IC, organizations have made a tradeoff as analysts have given less attention to gaining long-term understanding of the strategic environment in order to focus on changing current intelligence needs.[12] Studying the environment over a longer term allows analysts to learn more of the critical factors and relationships necessary for gaining a more complete and holistic viewpoint.

Another noted deficiency is the reliance on classified sources. While analysts increasingly use unclassified sources, analytical bias remains toward classified sources, which decision-makers often consider more reliable. To gain an appreciation of the range of factors, especially for SCA, SNA and "outside-in thinking," analysts need to consider

11. *Tradecraft Primer*, 30.
12. Treverton and Gabbard, 6.

a wide variety of sources collected from both open and classified systems.[13] This is especially important when considering complex systems in which critical relationships and other factors may remain hidden from classified collection, but remain in the open on social or other media. For example, during the 2009 Iranian student protests, the news media, along with social media venues such as Twitter and YouTube, kept U.S. leadership informed of the ongoing events with strategic implications, even though the U.S. IC had limited access in Iran.[14]

Intelligence analysts learn to separate intelligence into specific categories. Normally, such information is color coded after separation into "red" information regarding the enemy or threat, "green" information about partner nation military forces or government entities, and "white" information regarding neutral entities or the population at large. ("Blue" information, the fourth color, represents friendly, or U.S. forces, and for a variety of reasons, intelligence analysts typically do not conduct analysis of friendly forces.) Analysts may therefore fall into a reductionist "red, white, green" approach of focusing on discrete systems rather than viewing the environment holistically. Analysts therefore miss possible connections between entities in different networks.[15] This segregation of elements can be particularly detrimental to the identification of critical factors in the environment, especially when determining the dynamics and relationships between the critical actors. For example, U.S. intelligence failed to anticipate how U.S. military (blue) actions regarding the Government of Iraq (green) in 2004-2005 negatively

13. Treverton and Gabbard, 35.

14. Matthew Weaver and Saeed Kamali Dehghan, "New Protests in Iran," *The Guardian*, November 4, 2009, http://www.theguardian.com/world/blog/2009/nov/04/iran-student-day-protests (accessed January 27, 2015).

15. Connable, 1-20.

affected much of the Iraqi population (white), which contributed to the rise of the Islamic State (red) in recent years.[16]

COMPLEXITY CONFOUNDS STRUCTURED TECHNIQUES

The aforementioned analytical methods of SNA, SCA, and "outside-in thinking" are a necessary first step toward understanding the critical factors, relationships, and dynamics in the strategic environment. However, the complex and nonlinear strategic environment in which the U.S. military operates presents several challenges to the traditional techniques of structured analysis. These challenges include irreducibility, unclear cause-and-effect relationships, and unpredictable results.

The first step in most structured analytical techniques is to identify an analytical model in order to begin decomposition of the problem. Once an analyst has broken a problem into its components, the analyst can manipulate each part, looking for causal relationships and identifying critical factors.[17] The strategic environment, however, is too dynamic and complex to break into constituent parts. Complex systems have large numbers of components, and those components have changing relationships unbounded by identifiable rules.[18] In a closed or linear system, analysts may reduce a problem to its component parts, and when reconstructed, the whole will be equal to the sum of those parts. In complex systems, small interactions within one component may have a much larger aggregate influence on the overall system, one that analysts cannot predict by

16. *Frontline*, "The Rise of ISIS," Public Broadcasting System, originally aired October 28, 2014, http://www.pbs.org/wgbh/pages/frontline/rise-of-isis/ (accessed January 27, 2015).

17. Heuer, 89.

18. L. A. N. Amaral and J. M. Ottino, "Complex Networks: Augmenting the Framework for the Study of Complex Systems," *The European Physical Journal B*, May 14, 2004, http://amaral.northwestern.edu/Publications/Papers/Amaral-2004-Eur.Phys.J.B-38-147.pdf (accessed November 10, 2014).

analyzing the components individually.[19] Non-linear systems do not lend themselves to reductionist analytical techniques such as those taught to intelligence analysts.

Relationships between entities in complex systems are fluid, so the concept of cause-and-effect does not apply as expected. In a closed or linear system, processes are repeatable and applying a known stimulus to the system will provide a specific result. Thus, causes and effects are repeatable and predictable.[20] In complex systems, a small stimulus can produce a large and unpredictable result. The same stimulus applied repeatedly to a complex system would produce different results each time.

When one component in a complex system receives a stimulus, the immediate reaction may be predictable; however, the dynamic interconnectedness of the elements will likely create second- and third-order effects, both desired and undesired, that are very hard to predict.[21] For example, when the U.S. Government took actions to combat drug trafficking in the Caribbean basin, drug traffickers moved operations to Mexico and Central America, creating new and unforeseen problems for those countries and the United States. Actions taken in complex environments have multiple effects, many of which are unforeseeable, making predictive warning extremely difficult and suggesting the need for a new approach to anticipating surprise.[22] Complexity theory provides the foundation for such an approach.

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19. James Moffat, *Complexity Theory and Network Centric Warfare*, (Washington, DC: CCRP Publications Series, 2003), xi.

20. Czerwinski, 9.

21. John Mansfield, *Nature of Change or the Law of Unintended Consequences: An Introductory Text to Designing Complex Systems and Managing Change* (London, GBR: Imperial College Press, 2010), 7, ProQuest ebrary (accessed November 11, 2014).

22. Dietrich Dörner, *The Logic of Failure: Recognizing and Avoiding Error in Complex Situations*, trans. Rita and Robert Kimber (New York: Metropolitan Books, 1996), 15.

CHAPTER 4

THE COMPONENTS OF COMPLEXITY THEORY

Complexity theory is a relatively new scientific discipline. Unlike the reductionist approach of breaking phenomenon into components to understand how each part functions and interacts, complexity theory looks at the environment as a whole. Complexity theorists do not try to find simple cause-and-effect explanations for events, because they understand that small changes, when applied to components of complex systems, can result in large, unpredictable outcomes. Complexity theory does not seek laws or rules about environmental behavior, but offers different ways of considering behavior based on the interactions and relationships between components. Experts on complexity theory thus can provide different ways of thinking about the strategic environment that would be useful for intelligence analysts by supplementing current structured analytical techniques.

Complex systems are those with interconnected components that adapt to their environment or other stimuli.[1] Typical characteristics used to describe complex systems include the interrelated concepts of nonlinearity, emergence, feedback, and self-organization. Nonlinearity describes systems in which the output is not directly proportional to the input.[2] Emergence, or emergent behavior, is an attribute whereby the application of a small stimulus to a system can produce a much larger result due to the interaction between components of the system.[3] Feedback, whether from the past in the

1. Page, lecture 1.
2. James Gleick, *Chaos: Making a New Science* (New York: Penguin Books, 2008), 23.
3. Peter Baofu, *The Future of Complexity: Conceiving a Better Way to Understand Order and Chaos* (Singapore: World Scientific, 2007), 13.

form of memory, or from a current stimulus, modifies the behavior of an entity in some way.[4] Self-organization is "the capacity … to develop or change internal structure spontaneously and adoptively in order to cope with, or manipulate, [the] environment."[5] In nature, these four characteristics are working together when all members of a school of fish or flock of birds change direction together in response to predator or prey, without central direction. These concepts of complexity theory should inform the way intelligence analysts think about the strategic environment.

UNPREDICTABILITY AND UNEXPECTED BEHAVIOR

Most systems are complex, such as weather, the spread of disease, the Internet, international finance, and social interactions among groups of people. Additionally, all of these systems contribute to the overall complexity of the strategic environment. Of critical importance, a complex system's components exhibit certain behaviors only in relationship to other components within the system.[6] The amount and type of interaction affect the individual element's behavior. These interactions are dynamic, and as such, observers cannot use rules or patterns to predict future behavior.

Due to the natural cognitive limitations of the brain, people tend to have trouble making predictions about future events in complex systems. No one can use an analytical method to predict the future accurately, and complexity theory will not provide a means to do so. The previously described characteristics of complex situations make accurate predictions extremely rare, especially the type of intelligence predictions that lead directly to operational successes. For example, complexity theory does not provide any

4. Johnson, 14.

5. Paul Cilliers, *Complexity and Postmodernism: Understanding Complex Systems* (London: Routledge, 2002), 90, ProQuest ebrary, (accessed November 11, 2014).

6. Mansfield, 13.

new insight for targeting individuals inclined toward "lone wolf" terrorist attacks. However, complexity principles can help intelligence analysts recognize changes in the environment and anticipate emergent behavior. This may provide insight into the type of person susceptible to terrorist organization messaging, the rise of a new terrorist organization, or the future actions of a current one.

Part of the difficulty, especially when dealing with human societal interaction, is that the world does not function like a closed laboratory experiment where trial and error can lead to discoveries. Instead, the strategic environment poses a series of "wicked problems," which offer no way to test a solution, and no opportunity for trial and error.[7] Once entities in a complex environment receive a stimulus and an observer records the reaction, researchers cannot reproduce that interaction to record similarities or differences. The tendency of a complex environment to adapt and spawn a new behavior makes reproduction of a past event virtually impossible.[8] In addition, complex systems generate and respond to feedback, which changes continually as actors accrue memories of prior stimuli and events.[9] Complexity theorists can only study past events to infer general patterns and seek clues about how something similar may occur in the future.

Additionally, social interactions do not abide by principles of physics or other scientific interactions that mathematicians can easily capture in algorithms. Observable actions, at the macro level, are normally reactions to a series of smaller actions, at the

7. Horst W. J. Rittel and Melvin M. Webber, "Dilemmas in a General Theory of Planning," *Policy Sciences* 4 (1973): 155-169.

8. Moffat, xii.

9. Johnson, 54-55.

micro level, which are difficult or impossible to observe.[10] One cannot simply express such complex interactions by a formula.

ALTERNATIVE PERSPECTIVES ON COMPLEX SYSTEMS

While some complexity theorists have tried to develop algorithmic formulas for coping with complexity in their area, others have focused on developing nonmathematical principles. Formulas generally rely on creating simple rules for individual element behavior, which are not able to capture accurately the array of interactions that can take place in a nonlinear system. Some of the nonmathematical principles, however, show analytical promise and offer useful ideas for dealing with uncertainty in complex environments.

Intuition. Defense intelligence at the strategic level is both an art and a science. Although most complexity theorists tend to be either physical or social scientists, artists must also cope with complex environments. An architect, for example, also works at the boundary between art and science. One architect has discussed relying on intuition to begin his process of creating an architectural solution. Rather than trying to take in and analyze all applicable data, the architect relies on experience, judgment, and a feeling for "right" to get to his proposed solution. From there, he constantly reevaluates his solution in an attempt to improve it. The benefit to such a method is allowing the artist to get to a solution quickly, without allowing the data to overwhelm him.[11] In Clausewitzian language, this is the architect's *coup d'oeil*, or inward eye, that allows one to conclude

10. Steven V. Weijs, *The Data Processing Inequality and Environmental Model Prediction*, Proceedings of the 7th International Congress on Environmental Modelling and Software, June 15-19, 2014, San Diego, CA, http://www.iemss.org/society/index.php/iemss-2014-proceedings (accessed November 11, 2014).

11. Bobo Hjort, "Drawing, Knowledge, and Intuitive Thinking: Drawing as a Way to Understand and Solve Complex Problems," in John Casti and Anders Karlqvist, (ed), *Art and Complexity* (Amsterdam, NLD: JAI Press, 2003): 59-61, ProQuest ebrary, (accessed November 11, 2014).

quickly what normally would have taken much study and deliberation.[12] In some situations, intuition may serve as a better starting point than reductionist analysis.

Signals and Emergence. Complex environments contain diverse entities that are independent, but interconnected. The interaction and the relationships between these individual components give rise to complex behavior that is hard to predict. Each of the components responds to various stimuli, produced internally or imposed externally. The response to stimulus leads to new, or emergent, behavior, as the system seeks a new equilibrium following the change brought about by the stimulus.[13] Thus, the identification of external "signals" coupled with known or assessed adaptive behavior can result in the identification of emergent behavior. Complexity theorists refer to such systems as self-organizing, because there is no external force necessarily organizing the behavior. Rather, each of the individual components seeks a solution that will put itself back into a state of equilibrium, pending the next internal or external stimulus.

As an example, consider how the announcement of a new product for sale can result in consumers forming lines outside of stores that will sell that product. No central force organizes the behavior; instead, individuals respond to the signal regarding the product for sale and feedback from other individuals who want to purchase the product to arrange themselves in a manner to achieve the desired result. Before the product announcement, the consumers are in equilibrium, as there is no product for them to want, and they do not want it. After the announcement, they are no longer in equilibrium, as the

12. Carl von Clausewitz, *On War*, trans. and ed. Michael Howard and Peter Paret (New York: Alfred A. Knopf, 1993), 118. Malcolm Gladwell also discusses this concept at length in *Blink: The Power of Thinking without Thinking* (New York: Little, Brown and Co, 2005).

13. Melanie Mitchell, *Complexity: A Guided Tour* (Cary, NC: Oxford University Press, 2009), 13, ProQuest ebrary, (accessed November 11, 2014).

product exists and they want it, but do not have it. Their behavior allows them to achieve a new equilibrium, in which they both want the product and have it. They can then return to their normal behaviors, with the added change of incorporating use of the new product. This simplistic example demonstrates how intelligence analysts may incorporate the idea of identifying a signal that will stimulate a reaction from individuals to determine emergent behavior, even from disparate elements within the environment.

Identities. The dynamic interactions between components help to define the complexity of a system. These components rarely interact with only one other element of the system, as there is normally an interconnected array of positive and negative feedback loops. As such, the perception of a component's identity can change depending on the other components with which it is interacting.[14] Thus, analysts may view the relationships themselves as a type of variable, which will change over time in relation to other entities and with respect to the person observing the relationship. With this line of thought, entities lack "permanent identities." Their character varies with different relationships. As an example, consider how children commonly assign their elementary school teacher a single identity, associated with the time they spend in school. Children often find it shocking to see their teacher outside of the school environment, and cannot picture the teacher with a different identity, as a parent or neighbor. Intelligence analysts must consider all identities associated with entities in the strategic environment.

Variables. As noted previously, complex environments contain a large number of interrelated components. Analysts' limited cognitive capabilities prevent them from comprehending, describing, and tracking all of the various components and relationships.

14. Cilliers, 7-12.

An alternative view of the environment is one that avoids the individual relationships and behaviors to see larger trends or patterns that arise from the complex interactions.

Each entity and associated relationship in an environment is a variable. Thus, within the strategic environment, multitudes of microvariables represent each person, dollar, individual weapon, and every other critical actor as well as the relationships between those entities that make the strategic environment so complex. To reduce the complexity to a more manageable level for analytical work, macrovariables may represent groups of those entities to reduce the number of strategic factors.[15] Consider, for example, predicting traffic conditions. To analyze conditions by examining all of the components properly, an analyst would have to know the start and end points, start time, route, and rate of speed for every car traveling on a particular road network. Such an amount of information would be virtually impossible to collect, store, and track. Instead of tracking the actions of each car, or microvariable, a traffic analyst might keep track of macrovariables, such as the normal amount of traffic during certain times and locations along the road. Thus, if a stimulus occurs, such as a traffic accident, an analyst can better predict the effects, or emergent behavior, of that traffic system without having to know how the accident will affect each vehicle individually. Intelligence analysts can use a similar technique for considering the potential activities of the multitude of actors comprising the strategic environment.

Universality. Along with the concept of macrovariables is the principle of universality or universal properties. Individuals, when in large enough groups, tend to

15. Michael Strevens, *Bigger Than Chaos: Understanding Complexity through Probability* (Cambridge, MA: Harvard University Press, 2003), 11.

show the same behavior as other individuals in similarly large groups.[16] As an example, children in the United States may be very different from children in Russia, but while they are in their respective schools, their behavior will likely be similar. To understand how Russian children behave in school, one could more easily learn from observing schoolchildren in the United States. This principle can be beneficial to an intelligence analyst, because the analyst would not have to be able to observe a particular complex system, but could still be able to comprehend how that system operates from observations of a similar system.[17]

The traditional methods of analysis do not provide a sufficient level of insight into complex systems. New tradecraft is necessary to transition from current techniques to new ways of thinking. Complexity theory is the science that provides the tools necessary for intelligence analysts to succeed in the coming decade. Analysts must embed the principles of complexity theory into their tradecraft until it becomes second nature to them. This transition will require new doctrine and procedures, but most importantly will require new training techniques for intelligence analysts.

16. Johnson, 69-70.
17. Amarala and Ottino, 150.

CHAPTER 5

ADAPTING ANALYTICAL TRADECRAFT

In the foreword to *Joint Vision 2020*, the CJCS stated that the U.S. military is entering a period of transition following a decade of war.[1] With the end of major combat operations in Iraq and Afghanistan, the United States faces an environment that looks a lot like an interwar period, but not one devoid of conflicts and crises. Then Secretary of Defense Hagel echoed those sentiments in a 2014 speech, in which he said the U.S. military was operating in an uncertain environment and "must be prepared to address a broad range of … unpredictable contingencies for years to come." He touted the DOD's efforts to prepare for future threats through innovation and institutional reform.[2] As part of the military's reformation, the DIE will need to incorporate complexity theory into intelligence analysis, while the volatile nature of the environment will make adopting new intelligence tradecraft both more necessary and more difficult.

Changing the tradecraft is crucial for intelligence analysts to maximize their ability to provide actionable predictive analysis. DOD intelligence leaders need to incorporate principles of complexity theory into analytical tradecraft in order to anticipate threats, provide adequate warning, and support commanders' requirements for future operations. The most logical way of incorporating these ideas into common practice is to introduce them in the schools and training programs that teach analytical methods to strategic intelligence analysts. Analysts can apply the principles of complexity theory to

1. *CCJO*, iii.

2. Chuck Hagel, "A New Era for the Defense Department," *Defense One*, November 18, 2014, http://www.defenseone.com/ideas/2014/11/new-era-defense-department/99392/?oref=d-river (accessed November 19, 2014).

intelligence problems in the strategic environment to make more comprehensive predictions about broader sets of challenges.

INTERWAR INNOVATION

Military adaptation of new tactics or technologies during war is common. During an interwar period, such as the one in which the United States currently finds itself, adaptation and innovation face several hurdles. While several interwar innovations have been successful, many other attempts were not. Innovation during an interwar period can be effective, but history has shown that innovation fares better in the presence of certain favorable conditions, such as having a goal, being able to overcome bureaucratic inertia, and linking new technologies to operational concepts. Therefore, for the DIE to incorporate the principles of complexity theory into its analytical tradecraft successfully, it must link the Chairman's proposed concepts of operation to actual joint doctrine and training.

To improve the likelihood of success, innovators should have a specific goal toward which they drive transformational endeavors, and they should tie that goal to operational requirements. Prior to World War II, both the United States and Japan saw the potential for conflict between the two nations, and realized they needed to extend the operational reach of their combat power. The result was that each developed a significant aircraft carrier fleet before entering hostilities.[3] The key to each country's success was that it had a problem to overcome in the form of the other country's capability. Today's threats are actors who operate asymmetrically to do harm to our national interests.

3. Williamson Murray and Allan R. Millett, eds., *Military Innovation in the Interwar Period* (Cambridge, UK: Cambridge University Press, 1998), 311.

Paradoxically, the very reason the U.S. defense intelligence needs to adapt is that the strategic environment is so complex that there is no clear threat against which to prepare.

Historically, military culture has been conservative, seeking to maintain the status quo in size, organization, and operations. To be successful, innovators must overcome this reluctance to change.[4] For DOD intelligence innovation today, leaders will need to incorporate new procedures across several agencies and all the Services. The implementation of change within one organization is difficult, and expanding that across multiple organization increases the challenge significantly. As the DIE itself is a complex system, leaders must anticipate and mitigate unintended consequences that come from attempts to adapt and reform.

The most successful interwar innovations have generally been holistic in nature. That is, innovators successfully linked technology, operational concepts, doctrine, and training together in a synergistic manner to change the entire context of how they fought wars. To integrate complexity theory effectively, the DIE will need to incorporate the associated principles into operational tradecraft, codify them in publications, and train new analysts to think holistically about complexity.

ANALYTICAL TRADECRAFT INNOVATION

The DIE will have to adjust its tradecraft training and doctrine to incorporate the principles of complexity theory in order to prepare for an increasingly complex future environment. This will require intelligence leaders to prepare analysts to evaluate the strategic environment using the same principles as other experts who deal with complexity. Because complexity is so wide-ranging, and complexity science is so new,

4. Murray and Millett, 312-318.

complexity theorists have been attempting to determine if observations from one type of complex system can inform interactions in another type of environment.[5] The DIE can benefit from such innovative ways of thinking, to determine whether other fields can help analysts make better predictions. Additionally, DOD analysts should learn to keep an eye on the work of other complexity theorists making predictions about climate change or pandemic diseases to determine the effects on U.S. military interests.

Analysts should not completely avoid using reductionist analytical methods. Defense intelligence leaders, however, must avoid focusing analysts' training only on such methods. The structured analytical approaches do not equip analysts with essential tools for providing warning in complex environments. Intelligence training should provide analysts with a variety of methods, models, and thought processes.

Defense intelligence analytical training must incorporate methods of looking at the environment holistically, rather than attempting to break the environment into separate but related networks. Analysts will have to look at relationships between entities in the environment as critically as they look at the entities themselves, and consider the dynamic nature of those relationships as well. Analysts should learn to identify the "equilibrium" or status quo behavior of networks within the environment, and identify the stimuli that will lead to new or emergent behavior. It is necessary that analysts understand how to find similarities in complex environments, and use behavior in one environment to predict responses to similar signals in similar environments.

Understand the whole picture. As already described, analysts have had the tendency to break the strategic environment into categories (red, white, green, blue) and

5. Johnson, 16.

focus on those categories individually. To gain understanding of an open, complex environment, analysts cannot look only at one portion, but must be able to see the interactions between components themselves and between components and their environment as well.[6] Defense intelligence must not separate, but must blend red, green, white, and even blue analysis in an attempt to understand the variables and the interaction between key components in the strategic environment. Analysts will have to factor friendly actions with other forms of stimuli to determine effects on entities in the environment, including undesired second and third order effects. A holistic view is essential for outside-in and similar types of analysis.

The changing nature of interconnectedness in the future makes this principle even more critical. In less technologically advanced parts of the world, interconnectedness currently exists only in small areas. However, as the growing number of satellites, cyberspace communications, and business connections provide connectivity to more parts of the world, analysts must take into consideration that actions in one part of the world may have consequences in another. What analysts may once have considered a local event may now assume strategic relevance, such as how coastal piracy in Africa, in light of the world oil trade, has led to economic and behavioral ramifications in Europe, the Middle East, and the United States. In essence, a small stimulus could create a large, emergent behavior by other actors in other parts of the world.

In addition to identifying the components, analysts must also identify the nature of the relationships between the components. When looking at the strategic environment regarding transnational organized crime, for example, it is not enough for an analyst to

6. Connable, 13-14.

conduct SNA on only the criminal (red) networks. Analysts must understand how criminal organizations interconnect with commercial and financial organizations (white), and must understand the interplay with partner nation security and legal forces (green). Further, analysts must also understand how friendly (blue) actions can act as a stimulus on the entire system, and what emergent behaviors may result. For example, a United States-led effort to work with a partner nation to stop illicit trafficking in one part of the world may drive criminal activity to emerge in an area not previously used for trafficking. Thus, the combined blue (U.S.) and green (partner) activity can create emergent behavior in the red (criminal) network and its interactions with white (neutral) actors.

Focus on relationships rather than components. Defense intelligence should consider variable relationships rather than static relationship structures. Relationships are important as they provide positive or negative feedback between two entities. As the feedback changes, the nature of the relationship can change with it. Feedback in humans is stored as memory, demonstrating the importance of analysts understanding the impact of history on the current strategic environment. Attempting to predict behavior without understanding history will certainly lead to faulty conclusions, as evidenced by analysts' lack of understanding of the historic interactions between different ethnic groups following the break-up of the former Yugoslavia. A similar phenomenon occurred after the overthrow of Saddam Hussein in Iraq, as memories of historic interactions between the religious groups came to the forefront and shaped the violent interactions that continue to this day.

When conducting SNA, analysts often produce a link diagram that shows identified entities within a network and the relationships between those entities. While these diagrams serve an important purpose, this reductionist approach may limit the ability to consider the relationships between the key components and the environment itself. Additionally, the static diagrams limit the ability to note the changing relationships between entities in the network.

For example, an analyst may construct a link diagram that shows a TCO and the financial institution that the TCO uses for money laundering, and identify the relationship between the two as such. However, this diagram may not contain important environmental components such as laws or financial regulations, or the interest of law enforcement agencies regarding financial irregularities. The introduction of a new aggressive law enforcement policy may increase the bank's concern of being caught conducting illicit activity, leading the bank to reduce the number of transactions it conducts with the TCO. Thus, environmental—or external—factors will change the financial institution's willingness to continue its dealings with the TCO, thereby changing the previously identified relationship between the financial institution and the TCO. Through monitoring the amount of transactions, an analyst may determine that the TCO no longer uses this particular bank. By understanding the environment holistically and anticipating emerging behavior, the analyst may then provide warning of other banks that the TCO is likely to begin using. Analysts must learn to see the variability in relationships in order to anticipate how external or environmental factors can change the nature of the relationship and the resultant activity of the associated actors.

Recognize changing identities. While analysts must identify the actors in the environment and the relationships between those actors, they must also learn that identities of actors will change depending on the perspective of the other actors with whom they have a relationship. For example, an analyst may identify an organization as an actor that provides financial support to terrorism, and observe the relationship between that organization and various terrorist organizations. At the same time, that organization may provide essential services or do charitable work for important population centers around the world. In the color-coded analysis, this organization would occupy space in the red, green, and white systems. Analysts must consider that any action taken against this organization based on its red identity will have subsequent effects on the white and green systems as well. An analyst can then work with planners to identify friendly activities that are least likely to cause further hostility among the host nation and neutral actors. This is another reason why it is important to view the environment holistically, instead of reducing it to separate systems.

Identify signals that may lead to emergent behavior. Analysts should identify the "signals" in the strategic environment in order to anticipate emergent behavior. To accomplish this, analysts must learn to look for "equilibrium" or status quo behavior in an environment. Complex environments are never in complete equilibrium, which is why they are susceptible to stimulus; however, complex systems do seek to find a balance that leads to a reduction in energy expenditure. Once the stimulus creates an effect on the system, the system components will react in such a way to maximize benefit or reduce harm from the stimulus.

As an example, an analyst may determine that the state of cybercrime has reached an equilibrium, where the capabilities of criminal organizations and those that provide cyber defense are nearly equal. The introduction of a new technology may prove to be a catalyst to create emergent behavior for a criminal organization, who will use the new technology to maximize their criminal activities. Analysts must look as well for the second and third order effects of the emergent behavior, as potential victims, cyber security professionals, and law enforcement agencies react to minimize the harm that comes about from the emergent criminal activities. An effective countermeasure would act as another stimulus on the system, allowing the system return to equilibrium, albeit a new equilibrium that has changed from the previous status quo.

Currently practiced traditional reductionist analysis will not be effective for a situation like the one described above. The unpredictability inherent in a complex environment does not lend itself to predetermining likely outcomes, and then creating a matrix of identifiable signposts or indicators that help to predict one outcome over the other. While analysis of competing hypothesis and similar methods of analysis can be useful in certain circumstances, their use may prevent analysts from identifying unpredictable stimuli and emergent behavior. By maintaining awareness of all strategic factors, however, analysts may be able to identify changes that could lead to behavior that would otherwise have been unpredictable.

Use representative macrovariables and universality. While analysts should strive to comprehend all of the critical factors in a system, the strategic environment is too complex to identify and track every component and every relationship. Rather than trying to understand the interactions of each component, one technique for trying to

comprehend complex systems is to attempt to find simplistic behaviors that emerge from large numbers of component relationships. To employ this technique, analysts must learn to identify macrovariables, or large patterns of behavior, that represent microvariables, or the behaviors of individual components in the strategic environment. Because this technique relies on average behavior, it is more suited for larger systems with more components than for smaller organizations or networks.

Similar systems will act in similar manners, and analysts can use observed behavior from one system to try to predict the behavior of a like system. This principle is useful for analysts because some systems are much easier to observe than others are. For example, a TCO is very difficult to observe directly, but will likely exhibit behavior similar to a large retail corporation. When faced with similar stimuli such as product shortages, breaks in the distribution chain, or aggressive competition, the TCO's reaction will likely be similar as well. By observing corporate behavior, which is a much easier task, analysts can gain a better understanding of the TCO's likely operations. Similarly, analysts may be better able to predict the behavior of a newly formed terrorist organization by studying the behavior of those already existing. However, this method may lead to false conclusions if the number of entities in the organizations varies greatly.

Intuition. The use of intuition can be a good starting point to develop an overall understanding of the interactions in the environment; however, use by intelligence professionals could prove difficult, as it does not conform to the community's requirements to demonstrate analytical reasoning. Intuition avoids reductionism, or breaking systems into component parts, which is the limit of traditional analysis. IC leadership has a preference for the Newtonian analytical approach, as is shown in

Intelligence Community Directive Number 203, which requires analysts to demonstrate logical argumentation for their conclusions.[7] Decision-makers may lack confidence in warnings predicated on intuition.

7. Director of National Intelligence, *Analytical Standards*, Intelligence Community Directive 203 (Washington, D.C.: June 21, 2007), 4.

CHAPTER 6

CONCLUSION

During the first week of October 2024, the U.S. military will be conducting some of its current operations along with new and unforeseen missions. Some threats to the United States will be the same, while new ones will come from presently unknown individuals and organizations using technology that currently does not exist. Although no one can accurately see or predict the future, DOD intelligence analysts can learn to look for behaviors in the strategic environment that will allow them to anticipate emerging threats, challenges, and opportunities for the United States.

To anticipate future threats, intelligence analysts must learn and employ the basic concepts, principles, and techniques of complexity theory. Intelligence leaders must incorporate these techniques into analyst training and codify them into doctrine. These new techniques should supplement the currently taught structured analytical techniques, providing analysts with a new and varied set of tools that they may apply to view the strategic environment holistically.

Incorporating complexity theory will require much work. Defense intelligence leaders must become familiar with current thought on complexity theory. Because the science is still new, leaders will need to consider the many new ideas and discoveries that no doubt will come about. Leaders should develop new training programs and a cadre of instructors that are well-versed in complexity theory. Bringing about these changes will require overcoming resistance and bureaucratic inertia. The DIE may need to embrace ideas with which it is unfamiliar and uncomfortable, such as intuition.

AREAS FOR FURTHER RESEARCH AND STUDY

Changing analytical thinking about complex environments is a necessary step, but more efforts in this area may provide successful results. Mathematicians and computer scientists have begun work toward developing computer models for complex environments. Such models create simplistic rules for interactions between components of the systems. Without further instruction, the computer models can simulate the behavior of certain systems, such as the flocking of birds. Of course, those entities of most interest to intelligence analysts, such as humans, institutions, and organizations, do not behave according to a set of simple rules.[1] A strategic environment model would only be able to capture small portions of the overall picture, but that might help identify interactions that analysts would otherwise miss. To date, such models cannot predict specific future behavior, but may approximate the type of behavior a system may exhibit. The creation of a model that incorporates rules for factors in the strategic environment could be beneficial for intelligence analysts, if not as a way to predict future threats or events, at least as another tool to help understand the workings of the global system.

PREVENTING THE NEXT CATASTROPHE

In the increasingly complex and unpredictable strategic environment, it is comforting to seek certainty about future events from the IC. One may seek answers about predicting the future from other fields that study complex systems, such as biologists, climatologists, or financial managers. Such efforts, however, would be fruitless, as no profession has perfected a way to find certainty from complexity. No one has invented a crystal ball to see into the future, or even the supercomputer that can track

1. Johnson, 55.

all of the variables, relationships, and activities that comprise the environment and determine what will happen next. Instead, the best one can do at this point is study complexity and learn different ways of looking at the environment to discern universal patterns in the interactions between actors that may allow anticipation of future events. Understanding and applying complexity theory principles will help defense intelligence analysts avoid the next big surprise.

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